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AUTHOR Habib, Berthe
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ABSTRACT

Two services offered by Bellevue Community College's Multipurpose Math Lab are described in this report. The first of these is the lab's drop-in tutorial center, which offers tutorial support, worksheets, and other instructional materials to students at all levels of mathematics course work. This section of the report describes the philosophy of and rationale for the center; patterns of student use of the center and their attitudes towards it; the criticisms that have been made about the center and the establishment of a policy to insure that students understand what can be expected of the center; staff and personnel responsibilities; and physical layout. The remainder of the report describes the individualized, self-paced mathematics skills course offered by the math lab for students with arithmetic deficiencies. Specifically, the report examines the management of the course, which is continuously revised by a team of instructors; the rationale for the use of an individualized approach as a means of accommodating a variety of student skill levels; student diagnosis and placement; the flexible curriculum used; the course's emphasis on attitudinal development through attendance, mastery, and minimum progress requirements; and course completion rates. Finally, the report outlines nine steps which have been taken to enhance the image of the lab among faculty and students. (JP)

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# A MULTI-PURPOSE MATH LAB: A PLACE FOR ALL SEASONS

Berthe Habib
Bellevue Community Colleg e
Bellevue, Washington

Paper presented at the Re edial and Developmental Mathematics in College: ssues and Innovations Conference (New York, NY, April 9-11 1981).

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# A MULTI-PURPOSE MATH LAB: A PLACE FOR ALL SEASONS

by Berthe Habib
Bellevue Community College

The Math Lab at Bellevue Community College is a vibrant and friendly place, often crowded and noisy. It is a dynamic environment and it is highly regarded on our campus by administrators, instructors, counselors, and students.

Originally started under the Developmental Division, the Math Lab now is operated under the joint auspices of the Math and the Developmental programs. This administrative organization has been most beneficial to the reputation of the Math Lab, and has helped establish the validity of its services and effectiveness.

This successful Math Lab integrates two activities: (1) a drop-in tutorial center designed to assist students from arithmetic through calculus, and (2) an individualized, self-paced course, "Improving Math Skills", focusing on arithmetic and beginning algebra, and offering a flexible curriculum designed around the student's needs.

## THE DROP-IN MATH TUTORIAL CENTER

### A. Rationale and philosophy of the program:

Mathematics, unlike most other disciplines, is a cummulative subject, relying heavily on prior learning through retention of each topic and fluid ability in using past skills. Most students taking a math course on our campus have an imperfect baggage of knowledge either because of forgetting or through inadequate schooling in math. Hence, the Math Lab is a resource center where textbooks (written for self-study), teacher prepared worksheets and tutorial assistance are available to help students in their efforts to succeed in math courses. In addition, the tenuous math knowledge of many students needs reinforcement in a non-threatening situation. The Math Lab offers an environment where the students can admit their lack of understanding and commit mistakes without feeling vulnerable to ridicule or the low opinion of their instructors. Moreover, the Math Lab acts as a support system for the developmental math students as they are being mainstreamed into the conventional math courses on our campus. Students who have just completed the self-paced, individualized math course often need the Math Lab as a "security blanket" as they adjust to the pressures of conventional math course.

Finally, the Math Lab is a learning resource center for students taking any course requiring some level of skills in math. For example, many students from biology courses will visit the Math Lab for information on the metric system, and students from real estate courses will come to review their fractions and percents. Thus, the Math Lab is open to any student on our campus who has a math-related need, which can be met by our staff.

### B. Students' response: Who takes advantage of the program

The majority of drop-in students are highly motivated, hard working students whose math ability in conventional math courses ranges from "D" to "A". Seventy-five to one-hundred different students drop-in daily in the Math Lab between 8:30 am and 3:30 pm. Some students spend thirty minutes, others the whole period and some as much as a couple of hours, doing their homework, studying with classmates, consulting with tutors and using various textbooks

Multi-Purpose Math Lab
by Berthe Habib

B. Students response (cont)

as references. Most students use the Math Lab two to three times a week on a regular basis. Data collected a year ago indicated that about forty percent of all college math students visited the Math Lab at least once during the quarter.

The Math Lab is considered a real asset by the students who use it regularly. These students are grateful for its existence and are usually the best advocates for the program. On the other hand, the Math Lab has been criticized by some students, and as can be expected these students do not use it. The main criticism is of the kind of tutoring available in terms of (1) the length of time a tutor will spend with one student and (2) the emphasis by the tutors on the students' need to help themselves by reading the textbook before asking for explanations and by practising problems that have been explained.

In discussing these issues at our Math Lab staff meetings, we have been able to develop a consistent policy which articulates what can be reasonably expected by students and refering instructors from the drop-in tutorial service. This policy protects the peer tutors from abuse and also explains the type of service that is available. A handout was developed to give to anyone inquiring about the Math Lab and its drop-in service.

C. Lab staffing and organization:

Presently the Math Lab is open daily (Monday through Friday) from 8:30 am to 3:30 pm and twice a week in the evening from 5:30 pm to 8:00 pm. To meet the needs of the students who drop-in, the Math Lab is staffed by two Lab Teaching Assistants, each holding a BA or BS in Mathematics, one working six hours a day and the other three hours a day, and by approximately nine peer tutors each working one hour a day. Some of the peer tutors are paid but those tutoring for the first time earn credit. (A credited tutor training program was started about four years ago as a means to supplement our inadequate staffing level.)

As a rule, the Lab Teaching Assistants and peer tutors will each work with three to five students per period, spending from ten to twenty minutes with an individual student. In the given time, they are only able to clarify concepts, assist with working out a problem, and guide students towards other resources or reinforcing activities; they are not able to give a lecture or a lengthy explanation of the textbook, nor are they able to provide remedial instruction if the student is taking a course which is beyond his/her math ability. They are not expected to do the students' work but rather to facilitate it. Thus, students using the Math Lab are encouraged to try first and to communicate with classmates before having recourse to the tutors and Lab Teaching Assistants. The Math Lab tries to foster math study skills and to promote the student as an independent learner. Often a hint will be given rather than an explanation, particularly if the student has already received a certain amount of one-on-one tutoring. Many students seem to benefit immensely by receiving confirmation that they are proceeding correctly, and it is this support which seems to be the main catalyst in their progress.

C. Lab staffing (cont)

The physical set up of the Math Lab is such that students at all levels sit side by side: a calculus student might rub shoulders with someone reviewing fractions or starting algebra. The tutors usually circulate in the room and join the students at their tables to provide the requested help, and hence cannot be distinguished from the students they are tutoring. Many students are older adults and are often mistaken for Lab Teaching Assistants or tutors. This community of heterogeneous individuals, in terms of their roles and math ability, contributes to form a most vibrant environment and one of the warmest atmosphere.

This model has fostered communication among students at various math levels, and the resulting camaraderie has had an encouraging effect on students starting the struggle with math. Many of the tutors and students have become role models for others. The message often communicated is: "If he/she can do it, so can I!"

## IMPROVING MATH SKILLS: AN INDIVIDUALIZED AND SELF-PACED COURSE

A. Introduction:

In its eighth year, this dynamic math course is now a highly regarded entry level course on our campus. "Improving Math Skills" is routinely recommended by instructors, advisors, counselors, the Women's Center and students. The course was started as a means of responding to the math needs of our entering students. Initially, the lowest math course offered by our campus was beginning algebra, but before long it was recognized that a number of students had severe arithmetic deficiencies. An arithmetic course was started and taught in a conventional mode. But, shortly after its inception, the course was cancelled and replaced by a self-paced, individualized course which was the forerunner of our present course. Simultaneously, a Math Lab was set up where the course would be offered. Thus, the course and the Math Lab were started to address the remedial and developmental needs of a section of the student body and continues to do so today.

What distinguishes the course from most conventional math courses is its team approach in determining criterions and procedures as a means to unify the course and establish maximum consistency between instructors. The course is regularly discussed and revised by the team of instructors (four to five a quarter) teaching the course, using feedback and input from Lab Teaching Assistants, peer tutors and students. Thus, the effectiveness of the course and of its instructors is regularly being evaluated. The methods, the resources, and the grading criteria have been under constant scrutiny to ensure maximum results for the students and integrity for the course.

Presently, seven sections are offered quarterly, with a class size of approximately twenty students per section. The course is scheduled in the Math Lab and produces college credits which can be used as elective credits for graduation from the college's many vocational programs, but not towards the transfer program to four-year colleges and to universities.

B. Rationale for individualizing and self-pacing the course:

The twenty students registered in each of the sections are a most diversified group in terms of age, educational background, educational objectives and socio-economic status. The only bond is their declared deficiency in basic math skills. Again, this deficiency has a wide range of causes: some have been math avoiders since junior high or grade school, many have experienced repeated failure in math, many who initially had a good background have forgotten math from lack of use, many claim they never understood math before and are ready to learn it now, some are high school drop-outs, some have been poor students in every subject, and some have learning disabilities.

Under the circumstances, it would be meaningless to conduct the class as a single group since this population and its needs are so diverse. Thus, the course by necessity is individualized to respond to the students' background, ability levels and goals. It is self-paced to best accomodate the students' learning rates and provide the opportunity for mastery.

C. Student placement procedure:

After a thirty minute orientation discussing the purpose of the course, its structure, its minimum requirements for a passing grade and the organization of the Math Lab, the students are directed to fill out a survey which provides the instructor with a profile of each student. They are then asked to work on a "Math Skills Inventory". The instructor emphasizes that this is a diagnostic tool designed to assist both student and instructor in assessing the level at which each student should start in his/her math studies. The students are encouraged to skip all problems which do not seem solvable to them and are requested to check their answers with the answer key once they have completed the Inventory, noting the problems correctly solved. They are then asked to have a brief interview with the instructor, who recommends a learning strategy while making the student a strong participant in the planning.

The test used for placement is an instructor-made test, hand-written and dittoed off, in an attempt to reduce the anxiety level by making the testing procedure as informal and personal as possible. Usually, it takes two to three days to place all the students. To avoid having students sit idle, they are encouraged to be self-starters if they have diagnosed their own needs. The interview will be used in these cases as an opportunity to get acquainted.

D. A flexible curriculum for arithmetic and beginning algebra:

Most of the students will start with a review of arithmetic. For some the review is completed in 2 or 3 days, for others in 2 or 3 weeks, for many it takes the whole quarter and for a few it will take two or even three quarters as their entry level skills are at the second or third grade level. The most typical arithmetic sequence includes: fractions, decimals, ratio and proportions, and percentages. When this is completed various avenues are followed: some will go into beginning algebra as a stepping stone to a full math curriculum, others will direct themselves towards the needed math skills for the various vocational programs, i.e., business math for the secretarial and bookkeeping programs, the metric system, some knowledge of basic algebra including the arithmetic of integers, solving equations, working with formulas and scientific notation for those needing science courses or directing themselves towards one of the allied health programs.

D. A flexible curriculum (cont)

Some students are taking the course for personal growth and will "shop" around the available resources until they decide on a particular topic of interest. Others are preparing for a GED, a GRE, or a civil service exam and will practice test taking.

At the end of the quarter, many will take the course for a second quarter and pick up where they left off. This course has become a good alternative to the conventional beginning algebra course, which is too intense for many students. The individualized course allows many students to complete the equivalent of the first year of high school algebra in two quarters, including an initial review of arithmetic. They are then ready to continue into a conventional intermediate algebra course.

In addition to the flexibility in the curriculum followed by each student, the choice of resources is left to a large extent with the student. Various textbooks in a self-study format are available commercially and are purchased to equip the Math Lab with the necessary resources. A $3.00 lab fee, paid by the students in addition to their tuition, covers the cost of supplying the Math Lab with the resources which will be used by the students. No textbook is required for purchase - instead, students are encouraged to work from various books and supplement with the extensive selection of teacher-made worksheets and lessons. It is not unusual for a student to use two to three different books as primary resources. The diversity of resources is an important factor in responding to the student's learning style and reduces the difficulties which develop from a textbook ill-suited for a particular student.

E. Motivational components of the course and alternatives for the students who so far have experienced failure in math courses:

Great emphasis is placed on making the student into an independent and responsible learner. The student is encouraged to determine his/her level of understanding and competence and to resort to the instructor (as well as to other resources) for help and better understanding. As much as possible, the student is made aware of the extent to which he/she controls the direction and the outcome of the quarter.

As many students have poor study skills, the structure of the course heightens their awareness of what is needed for success. Requiring (1) daily attendance, (2) mastery and (3) minimum progress places subtle pressure on them to change their behavior.

(1) Daily attendance: Since daily attendance is impossible in some cases, students are required to make up days missed. We emphasize the commitment of "going" to school by "coming" to school. A student will not be passed if progress is satisfactory, but attendance is short. In discussing this requirement at our staff meetings we have become thoroughly convinced of its validity and its tremendously positive impact on the student. New instructors to the program with experience in similar individualized courses have repeatedly marveled at the effect of the attendance requirement as a motivator. Attendance is kept by students in their personal folders. This honor system is periodically verified by the instructor. Few students have cheated.

(2) Mastery: As in most courses of this nature our course emphasizes 80% on unit tests. For this purpose students have available to them pretests which assist them in determining their degree of preparedness. Two forms of the test are available in case the student doesn't score high enough on the first test.

(3) Minimum progress: One of the underlying rationales of the course is to provide an environment in which the student is "successful" in math, possibly for the first time in his/her life. We have noticed that such "success" gradually changes the behavior of many students towards math. The instructor's goal is to make math tolerable to the math anxious/avoiders, and to break the failure and drop-out syndromes which have plagued many students.

Our course has loosely defined minimum progress as "two units" of material. Those units are left to the instructor's discretion if necessary, but with the student's full knowledge of what the two units have to be. At first many instructors criticized the criteria as being too low, and a license for giving away credits. In reality, the amount of mathematics learned may be negligible, but this is compensated for by a change in attitude, a willingness to continue with math, a gradual improvement in study skills and often greater progress the following quarter. An important psychological tool lies with the fact that when the course is taken a second time it isn't being repeated but instead is being continued.

F. A look at retention:

The completion rate for the course is high for developmental classes. It averages about 70% for all seven sections, with attrition being greatest in the afternoon and evening sections and minimal in the daytime sections. The most important result is that of those students completing the course, a significant percentage continue successfully with their math education, some all the way to calculus and beyond, progression which would never have been available had it not been for taking "Improving Math Skills".

## COMMENTS

This paper describes Bellevue Community College's Math Lab as it is today. However, arriving at this status took some doing. Originally the Math Lab was independent of the Math Department and the attitude towards it was rather negative. This negative attitude was prevalent throughout the campus when I joined Bellevue Community College as a developmental math instructor about 6 years ago. The functions and services of the Math Lab were supposed to be as described previously, but the students who came to the Math Lab were those who were registered in the developmental math course scheduled there and those who found it accidentally - non-developmental instructors were suspicious of the Lab, and rarely referred students to us. The challenge of creating Lab credibility was thus set from the start. I was determined to create a valid product in the Math Lab and gain the recognition and support of campus math instructors, and I have been able to accomplish both. Some of the key elements which were pivotal in accomplishing this change in attitude were:

(1) Establishing recognition of th e developmental student: The technique was informal but it worked to raise a awareness that did not exist before. It consisted of inquiring casually f om math instructors about the progress of certain students who should be do ng reasonably well in the math courses they were teaching. This inquiry usual ly elicited curiosity as to how I might know a student, whereupon I would coyly omment that I had had the student in my developmental course the previous quarter. Hence, the developmental math stu- dent had become their "non-develop mental" student.

(2) Raising awareness of the types of students using the Math Lab on a drop-in basis: The technique here again as similar to the one described above. The purpose was to alert math instruct ors to the fact that some of their best stu- dents were using the Math Lab and perceived no stigma in doing so.

(3) Recruiting of math tutors: Ma th instructors were asked to recommend some of their better students to become ma th tutors. They were also informed who the tutors were at the time and were s urprised to discover that they knew most of them. Again, if one of the tutors (and t his has happened several times) was a former developmental student, it was stro ngly emphasized. This process was a reinforcer of the potential in developmental students.

(4) Hiring of Math Lab Teaching As sistant: A committee of 3 was set up including the Math Department Chairman, the Math Lab Director and the appropriate administra- tor when it was time to hire a new Math Lab Teaching Assistant. The Math Department Chairman at first was reluctant to participate, but he was persuaded that since the individual hired would be working with so many math department students, in the interest of the Math Department, t he selection should be made with his participation.

(5) Meetings: Two formats have oc cured. One has been to invite the Math Department Chairman to our Math Lab staff mee tings, which include Lab Director, Instructors, Lab Teaching Assistants and Peer T utors. The other format has been to invite the math faculty to the Math Lab to di scuss available resources and procedures, and to verify expectations. This latter issue is most important and a constant dialogue needs to be maintained.

(6) Assigning regular math instruc tors to teach the individualized developmental course: This practice started abo t two years ago and the results have been very promising. A new respect for deve lopmental instructors has occured, as successful instructors in regular math course have come to realize that special skills are needed to teach developmental stud ents.

(7) Assigning developmental math i nstructors to teach conventional math courses: This practice was started simultan ously with the previous one and also has positive results. The developmental math i nstructors assigned to teach the conventional math courses have done an effective ins tructional job, and thus gained respect from their colleagues in the math department.

(8) Upgrading the image of the dev elopmental math instructor: Closely linked to the image of the Math Lab is the image of the people who work there. Great pain has

been taken to develop a group of developmental math instructors who are compatible amongst themselves and with the Math Department. Although the formal math training of the various individuals involved with the Math Lab is varied, every one of them is respected for his/her skills and well liked as a person. Trust has thus developed through mutual consultation and a healthy relationship exists.

(9) Emphasizing discretion: Each individual working in the Math Lab is exposed to comments by students about their instructors. It has been the policy of the Math Lab to be very discrete about such comments. We have empathized with students about their frustrations, but have refrained from making value judgements about their instructors. This discrete attitude, in particular on the part of the peer tutors, has been noted by the math instructors and I am sure has contributed to the acceptance of the Math Lab as a professional unit.

In conclusion, it should be reiterated that the Math Lab where these activities are scheduled is a busy place, filled with drop-in students and student tutors who once, a few quarters ago, possibly took "Improving Math Skills" themselves. They are the role models who give hope and challenge to those at the bottom of the ladder of math skills, and who help the Lab provide an unusually warm and friendly atmosphere where frustrations with math are talked about, coping strategies are shared and the math studying goes on.